

## 0.a. Goal

Goal 12: Ensure sustainable consumption and production patterns

## 0.b. Target

Target 12.3: By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses

## 0.c. Indicator

Indicator 12.3.1: (a) Food loss index and (b) food waste index

## 0.d. Series

This metadata refers only to part (a) of the indicator 12.3.1: Food loss index.

## 0.e. Metadata update

2021-02-16

## 0.f. Related indicators

SDG Sub-Indicator 12.3.1b: Food Waste Index

## 0.g. International organisations(s) responsible for global monitoring

The Food and Agriculture Organization of the United Nations

## 1.a. Organisation

The Food and Agriculture Organization of the United Nations

## 2.a. Definition and concepts

### Definitions

**The Food Loss Index** - Index of the changes in food loss over time. The index covers five food groups along the supply chain. The indicator is computed as a ratio of Food Loss Percentages in the

current year and the Food Loss Percentages in the base year according to a standard fixed-base index formula.

Definition of food loss for SDG monitoring:

**Food losses** - are all the crop and livestock human-edible commodity quantities that, directly or indirectly, completely exit the post-harvest/slaughter production/supply chain by being discarded, incinerated or otherwise, and do not re-enter in any other utilization (such as animal feed, industrial use, etc.), up to, and excluding, the retail level. Losses that occur during storage, transportation and processing, also of imported quantities, are therefore all included. Losses include the commodity as a whole with its non-edible parts.

### Related concepts

**Food** – is any substance, whether processed, semi-processed or raw, which is intended for human consumption, and includes drink, chewing gum and any substance which has been used in the manufacture, preparation or treatment of "food" but does not include cosmetics or tobacco or substances used only as drugs.

**Food loss and waste (FLW)** – is the decrease in quantity or quality of food.

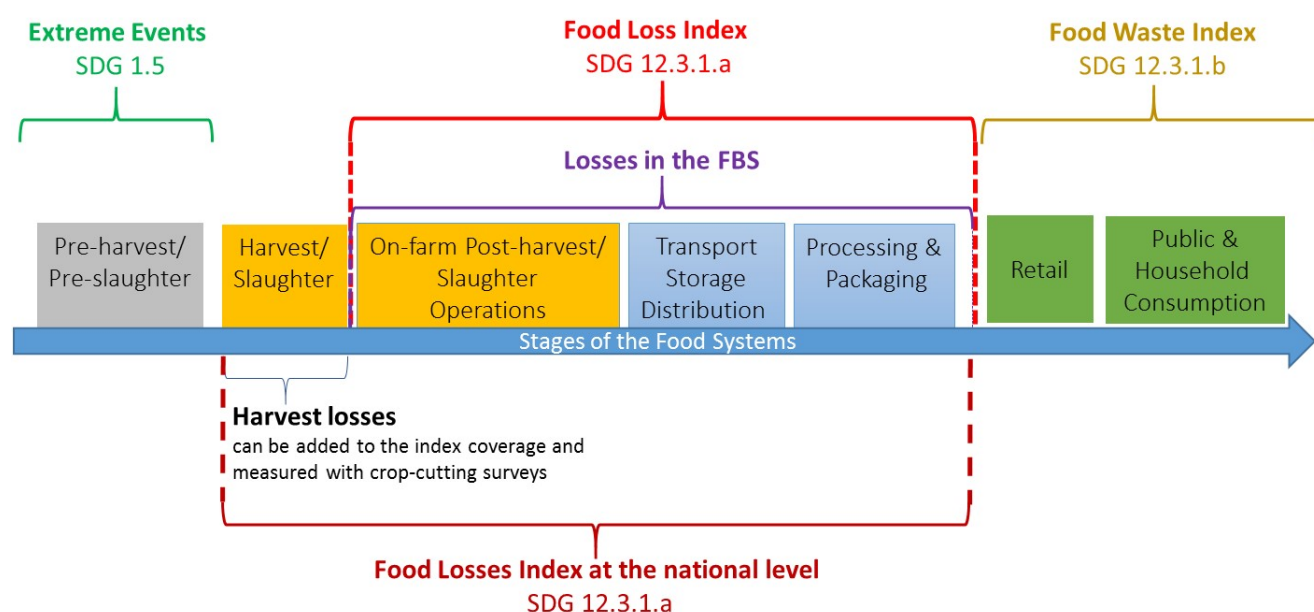
**Quantitative food loss and waste** – is the decrease in mass of food.

**Pre-harvest** constitutes the time frame between maturity and harvesting.

**Harvest/slaughter/catch** refers to the act of separating the food material from the site of immediate growth or production.

### Food Loss Index scope and boundaries

- The scope of the Food Loss Index starts on the production site with postharvest/slaughter/catch operations up to but not including the retail level, in line with the Food Balance Sheets conceptual framework.
- The index covers five food groups and 10 key commodities set by the countries.
- Harvest losses can be included in the index at the country level only.
- Pre-harvest losses are out of scope.
- Sub-Indicator 12.3.1(b) Food Waste Index covers food waste at the retail and consumption level.



## 2.b. Unit of measure

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The Food Loss Index has no unit of measure.

Food Loss percentages are expressed in percentage.

## 2.c. Classifications

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CPC 2.1 expanded grouped in 5 commodity groups, namely:

1. Cereals & Pulses
2. Fruits & Vegetables
3. Roots & Tubers and Oil-Bearing crops
4. Animals Products
5. Fish and Fish Products

## 3.a. Data sources

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1. Loss estimates from the Supply Utilization Accounts/Food Balance Sheets that are officially reported to FAO through the annual Agricultural Production Questionnaires.
2. Survey based loss percentages by commodity along the supply chain.
  - Agricultural surveys, value chain surveys, rapid appraisal methods, administrative data, business surveys.
1. Modelled estimates for non-reporting countries.
  - The FAO developed a food loss estimation model that uses available official data and data from scientific literature to estimate losses at the regional, food group and global level.

## 3.b. Data collection method

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The methodology and guidelines consider a range of data collection methods to reduce the cost of data collection. The emphasis is put on the critical loss points along the value chain.

The guidelines recommend representative sample surveys to ensure statistically representative, accurate, and comparable estimates especially when the sector is characterized by a large number of small actors (for example smallholders). Countries that already have a farm survey can add a post-harvest loss (PHL) module for the sake of cost-efficiency.

Food loss data collection can be interview based (subjective approach) or measurement based (objective approach), the former method is less costly but leads to under-estimation.

## 3.c. Data collection calendar

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The guidelines recommend carrying out loss surveys every three to five years, with lighter surveys in between based on declarations, as loss ratios tend to be stable, from one year to the next under normal conditions. The recommendation is also to add a loss module to existing surveys. The data collection calendar will therefore follow the calendar of the main survey.

To establish a baseline, it is recommended to carry out two or three consecutive comprehensive PHL surveys to establish a first solid set of preliminary estimates. Since estimates limited to a single year have a higher risk of being biased because of the occurrence of specific events (e.g. that are weather-related), as compared to estimates based on two- or three-year averages.

Loss estimates for the compiling Supply Utilization Accounts should be carried out every year.

### **3.d. Data release calendar**

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Loss data collection is taking place through FAO's annual Agriculture Production Questionnaire in May every year.

A separate data collection exercise took place in 2019 after the indicator had been upgraded to gather all the previously available information.

Loss data is released in FAOSTAT in December every year.

### **3.e. Data providers**

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National Statistical Offices

Statistical Units of the Ministry of Agriculture

### **3.f. Data compilers**

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Food and Agricultural Organization of the United Nations, Statistics Division, Methodological Innovation Team and the Crop Livestock Food Balance Sheet team.

### **3.g. Institutional mandate**

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Article I of the FAO constitution requires that the Organization collect, analyses, interpret and disseminate information relating to nutrition, food and agriculture

<http://www.fao.org/3/K8024E/K8024E.pdf>

## **4.a. Rationale**

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The 2030 Sustainable Development Agenda has emphasized the importance of sustainable production and consumption systems as efficient food systems, on the supply side and the consumption side, contribute to food security and sustainability of natural resource since agriculture is a major user of land and water.

The food loss and food waste index look at the entire supply chain and the trend in structural losses. The Food Loss Index monitors progress on the supply side of food chains, as it measures if the share

of agriculture production that does not reach the retail stage in 2030 has increased or decreased with respect to the base period and by how much. The numerator of the indicator indicates the level of losses and informs on the magnitude of the problem.

A greater efficiency of the food supply chain also has implications for all producers whether looking at efficiency in large-scale producers for export markets or in small-scale production units relevant for poverty and food insecurity reduction goals.

## 4.b. Comment and limitations

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Food losses are an extremely complex phenomenon to measure because they are multi-dimensional and data collection is costly.

A major limitation is data availability. The reported data accounts for a small percentage of the data needs: only 23 countries out of 185 reported on losses in 2016 for one commodity or more. The number of reporting countries was 42 in 2018 and 12 in 2019. As for the data only 7%% of loss factors in the SUA/FBS database are officially reported, all others being estimated.

The index scope was reduced for international comparability purposes to exclude harvest losses, which are critical at the production stage. Moreover, the index covers only two commodities in each food group, because requesting regular loss data for a larger number of products would be a difficult and unsustainable exercise for most countries.

The index monitors quantitative losses. Qualitative and economic losses that are also very relevant but not measurable in a consistent manner are out of the scope of the indicator.

This indicator is particularly challenging because it requires data along the whole supply chain. The most appropriate data sources would be an ensemble of surveys however, most countries lack the capacity and resources to carry out this exercise. A suite of statistical and modelling tools combined where possible with administrative records will have to be used.

## 4.c. Method of computation

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### Computation Method:

SDG 12.3 for a single country, called Food Loss Index (FLI), is a fixed-based index as follows:

$$FLI_{it} = \frac{FLP_{it}}{FLP_{i0}} = \frac{\sum_j l_{ijt} * q_{ij0} * p_{j0}}{\sum_j l_{ij0} * q_{ij0} * p_{j0}} * 100$$

Where:

- $FLP_{it}$  is the average food loss percentage of the country in the current year,
- $FLP_{i0}$  is the average food loss percentage of the country in the base year,
- $i$  = country,
- $j$  = commodity,
- $t$  = year, 0 is the base year
- $l_{ijt}$  is the loss percentage (estimated or observed) of commodity  $j$  in country  $i$  in year  $t$ ,
- $q_{ij0}$  is the production quantities of commodity  $j$  in country  $i$  in the base period,
- $p_{j0}$  is the average international price of commodity  $j$  (at international \$) in the base period.

For the FLI and FLP, the weights are the value of production at international dollar prices. The weight is fixed in the reference year.

## Commodity Coverage

The index covers five food groups and two commodities within each group:

1. Cereals & Pulses
2. Fruits & Vegetables
3. Roots & Tubers and Oil-Bearing crops
4. Animals Products
5. Fish and Fish Products.

Cross-country comparisons are possible at the group level, while the key commodities within groups can differ across countries. This, to ensure that the index is relevant to the countries while providing some degree of international comparability.

The default selection criterion for the commodities is to rank them by their value of production within each country and commodity group. The default process is to:

- Compile value of production for every commodity
- Sort the commodities by group and rank them
- Select the top 2 in each group

The default selection process is based on value of the commodity in international dollar prices in the base period. At national level, countries can use their own set of values, quantities or prices, or use different policy-based criteria, as long as the main headings are covered.

### Compiling a commodity food loss percentage: aggregating loss percentages along the supply chain

The FLI covers losses at the national level from production to the retail stage. Using the index notation, these percentage losses of each commodity are the  $l_{ijt}$  where:

$l_{ijt}$  is the loss percentage (estimated or observed) of commodity  $j$  in country  $i$  year  $t$

When loss estimates are available separately for the various stages of the value chain, they need to be aggregated into an overall percentage with the following simplified and standardized supply chain:

It is expected that the losses at each stage of the value chain are nationally representative.

The overall percentage of production that does not reach the retail stage ( $l_{ijt}$ ) can be obtained with the simplified process below, illustrated in the table:

1. Set a Starting Amount of product, 1000 tons in the example
2. Compile the Amount Lost at each stage by multiplying the Average Losses (%) of that stage to the reference quantity. The reference quantity is 1000 at the Production stage; in the other stages the reference quantity is the Amount Remaining from the previous stage.
3. Compile the Amount Remaining at each stage by subtracting the Amount Lost from the Amount Remaining of the previous stage.
4. Compile the percentage of supply still in the market at the end of the chain as the ratio of the last Amount Remaining and the Starting Amount.
5. Compile the loss percentage of the commodity  $l_{ijt}$  as the difference between the 100 and the % of supply still in the market

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|--|---------------------------------|-----------|---------|-----------|------------|
| Starting Amount - Agriculture production                         | 1000                            |           |         |           |            |
| Average Losses (%)   | Production                      | Transport | Storage | Wholesale | Processing |
|  | 7.3                             | 1.5       | 7.7     | 0         | 3.5        |
| Amount Lost  | 73                              | 13.905    | 70.308  | 0         | 29.497     |
| Amount Remaining   | 927                             | 913.095   | 842.787 | 842.787   | 813.289    |
|  |                                 |           |         |           |            |
| % of supply still in the market                                  | $81.3\% = (813.289/1000) * 100$ |           |         |           |            |
| $l_{ijt}$<br>=<br>% lost from farm to (but not including) retail | $18.7\% = 100 - 81.3\%$         |           |         |           |            |

## 4.d. Validation

Data sources for agricultural production and on-farm losses are mainly national agricultural surveys that are conducted by the Ministry of Agricultural/Livestock and/or the National Statistical Office. The surveys are usually annual, and in the absence of direct measurements, data are interview-based. Agricultural censuses, which FAO recommends conducting every ten years, may be the only available source of loss estimates in a number of countries that do not carry out annual surveys. Off-farm loss data along the value chain may be obtained through specialized surveys (supplemented by research) through the national agri-food industry system.

The data are provided in the Agriculture Production Questionnaire, in the Utilization sections used to compile Supply Utilization Accounts.

Utilizations of interest here are those quantities destined for, among others, animal feed, for industrial uses (e.g. biofuel production), for national/enterprise/farm stocks, for seed (sowing for the successive agricultural cycle) – to be able to infer on quality and economic losses, that are not covered by the definition and data collection, and to assess the overall data consistency in the validation phase.

These datasets (production, trade and utilizations including losses), once cross-checked and validated, form the basis for the compilation of the Food Balance Sheets (FBS). The FBS are an accounting framework whereby supply (production + imports + stock withdrawals) should equal utilization (export + food processing + feed + seed + industrial use + losses, etc.). It should be noted that, within the FBS framework, post-harvest/slaughter losses (up to the retail level) are considered as utilization, and thus a component in the balancing of the FBS. The FBS framework provides a snapshot of the agricultural supply situation at the national level, and allows for a cross-referenced structure whereby data, official or estimated/imputed, may be further analyzed and validated (e.g. animal numbers may result as being under-reported/estimated).

The new FBS Guidelines for national compilation (completed recently in collaboration with the Global Strategy) and new compilation tool (R-based ‘shiny’ application).

Detail on FBS methodology: <http://www.fao.org/economic/ess/fbs/ess-fbs02/en/>.

The FBS Handbook shown here should not be confused with the recently completed FBS Guidelines. The Handbook is of a more technical nature and explains the methodology followed by FAO in compiling country FBS. The Guidelines on the other hand, while based on the Handbook, provide countries with a more revised and practical guidance and recommendations for compilation at the national level.

Some FBS background text also available on FAOSTAT: <http://www.fao.org/faostat/en/#data/FBS>.

## 4.e. Adjustments

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There are no adjustments to the international classifications except for items in the Fish group, because the CPC is not used for FAO’s fish production statistics.

Fish and fish products are classified as per FAO’s Food Balance Sheet ICS categories as follows: Cephalopods (2766), Crustaceans (2765), Demersal Fish (2762), Freshwater Fish (2761), Marine Fish, Other (2764), Molluscs, Other (2767), Pelagic Fish (2763), Fish, Seafood (2960), Aquatic Animals, Others (2769), Aquatic Plants (2775), Meat, Aquatic Mammals (2768), Aquatic Products, Other (2961).

The FLI food groups are further aggregations of CPC groups.

## 4.f. Treatment of missing values (i) at country level and (ii) at regional level

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- **At country level**

In the absence of food loss data at the country-commodity level, FAO developed a loss imputation model to estimate losses of all countries and commodities and compile the Food Loss Index for SDG regions and commodity groups.

The model builds on loss data provided by the countries to the FAO within the annual Agriculture Production Questionnaires, loss factors available in the scientific literature published in the [FLW database](#) and from case studies, and a set of 200+ explanatory variables.

The model is a fixed effect model that selects the explanatory variables with a random forest algorithm. Where there is no information at all for a country-commodity combination, the model is applied to a cluster of commodities and the countries’ estimated loss percentages will be equal to the cluster’s at global level.



- **At regional and global levels**

When loss data is insufficient to estimate even one country-commodity combination, the countries' estimated loss percentages will be equal to the cluster's at global level for all the ten commodities in that country basket.

## 4.g. Regional aggregations

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At regional and global level, the GFLI is computed as:

$$GFLI_t = \frac{\sum_{i=1}^G FLI_{it} * w_i}{\sum_{i=1}^G w_i} * 100$$

by aggregating country indices using weights equal to the total value of agricultural production of each country (in the region or the world) in the base year.

## 4.h. Methods and guidance available to countries for the compilation of the data at the national level

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The main source of loss data at the national level are:

1. Official reports of loss estimates in the commodity balance sheets, Supply Utilization Accounts or Food Balance Sheets

Data sources for agricultural production and on-farm losses are mainly national agricultural surveys that are conducted by the Ministry of Agricultural/Livestock and/or the National Statistical Office. The surveys are usually annual, and in the absence of direct measurements, results are based on interview-based data on lost quantities of crop, animals and animal products. Agricultural censuses, which FAO recommends conducting every ten years, may be the only available source of loss estimates in a number of countries that do not carry out annual surveys. Off-farm loss data along the value chain may be obtained through specialized surveys (supplemented by research) through the national agri-food industry system.

The Methodology for monitoring SDG Target 12.3 : <http://www.fao.org/3/CA2640EN/ca2640en.pdf> has been published as a guide for countries in calculating the index along with a method to aggregate data from subnational stages of the supply chain to the national level. Subnational disaggregation will identify where losses occur and the scope of impact, sets the focus on where to make investments and aids in targeting intervention strategies and policies to decrease food losses along the supply chains.

The Guidelines for the measurement of harvest and post-harvest losses of grain produced by the Global Strategy are available at <http://gsars.org/en/guidelines-on-the-measurement-of-harvest-and-post-harvest-losses/> with an on-line training course available at <http://gsars.org/en/training-course-on-post-harvest-losses-english/#more-3855> . Additional material is available at <http://www.fao.org/sustainable-development-goals/indicators/1231/en/>

Other important documents that can guide countries in the measurement and compilation of the FLI are:

Reports on pilot testing the FLI : <http://www.fao.org/3/ca6691en/ca6691en.pdf>

E-learning course on SDG Sub-Indicator 12.3.1a : <https://elearning.fao.org/course/view.php?id=605>

## 4.i. Quality management

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FAO Statistics Division processes production, trade and food balance sheet data in an integrated Statistical Working System following the GSBPM.

Data in each domain are managed and processed with a set of modules and R scripts for data editing, outlier detection, imputation of missing data, compilation of derived indicators, aggregation, validation and compilation of quality indicators.

FAO Statistics Division engages with the countries during processing and validation.

## 4.j. Quality assurance

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For FAO, a sound statistical basis is essential in monitoring progress towards national and international development goals and targets. To ensure quality standards are maintained, the organization developed a Quality Assurance Framework for the FAO Statistics system (FAO SQAF) consisting of a quality framework and a mechanism to ensure the compliance of FAO statistics to the quality framework itself. The SQAF is available at <http://www.fao.org/3/i3664e/i3664e.pdf>.

With respect to officially reported loss data submitted by countries through the annual Agriculture Production Questionnaire, loss data is validated during the whole Supply Utilization Account/Food Balance Sheet processing and validation that entails a purely statistical approach based on outlier detection tests and validation routines and a consultative approach where countries are requested for additional information or clarifications. The same approach applies to the data received in 2019 though the ad hoc questionnaire on “Food Losses from Production to the Retail stage”.

More generally FAO complies with “Guidelines on global data flows” approved by UNSC 2018 for the national data submitted to FAO for the SDGs Indicators Database. With respect to losses that is extremely scarce dataset (7% of reported records in FAOSTAT in the period 1990-2016), and to the extent that country data has to be estimated with an econometric model, the estimates are validated with countries via an email asking for an authorization to publish them.

The available basic data still does not allow for the publication of the Food Loss Index at the country level but only at the regional level by commodity groups.

## 4.k. Quality assessment

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Datasets (production, trade and utilizations), once cross-checked and validated, form the basis for the compilation of the Food Balance Sheets (FBS). The FBS are an accounting framework whereby supply (production + imports + stock withdrawals) should equal utilization (export + food processing + feed + seed + industrial use, etc.). It should be noted that, within the FBS framework, post-harvest/slaughter losses (up to the retail level) are considered as utilization, and thus a component in the balancing of the FBS. The FBS framework provides a snapshot of the agricultural supply situation at the national level, and allows for a cross-referenced structure whereby data, official or estimated/imputed, may be further analyzed and validated (e.g. animal numbers may result as being under-reported/estimated).

## 5. Data availability and disaggregation

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Modelled regional estimates are available for the five commodity groups

### **Disaggregation**

Sub-indicator 12.3.1 must be disaggregated by product and stage of the supply chain at the country level. Countries will likely gain the most value from the disaggregated Food Loss Percentage at the sub-national level by geographic area or agro-ecological zone, points of the value chain (farm, transport, markets, processors), economic sectors (small-holders or traditional sector versus large and commercial farms/firms).

## **6. Comparability/deviation from international standards**

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Not yet applicable

## **7. References and Documentation**

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FAO, Methodology for Monitoring SDG Target 12.3 : <http://www.fao.org/3/CA2640EN/ca2640en.pdf>

FAO, Definitional framework of food loss 2014: [http://www.ipcinfo.org/fileadmin/user\\_upload/save-food/PDF/FLW\\_Definition\\_and\\_Scope\\_2014.pdf](http://www.ipcinfo.org/fileadmin/user_upload/save-food/PDF/FLW_Definition_and_Scope_2014.pdf)

GSARS, “Guidelines on the measurement of harvest and post-harvest losses”, <http://gsars.org/wp-content/uploads/2018/06/GS-PHL-GUIDELINES-completo-09.pdf> , 2018.

FAO, “FAOSTAT Commodity Definitions and Correspondences,” n.d.  
<http://www.fao.org/economic/ess/ess-standards/commodity/comm-chapters/en/>.